Shenandoah County, Virginia
Cooperating Technical Partner
Mapping Activity Statement

Agreement CTP01-01 – Digital Topographic Data Improvement

In accordance with the Cooperating Technical Partner (CTP) Memorandum of Agreement dated June 26, 2001, between Shenandoah County, Virginia and the Federal Emergency Management Agency (FEMA), Mapping Activity Statement CTP01-01 is as follows:

1. **Objective and Scope:** The objective of this Agreement is to improve existing digital topographic data for Stony Creek. The digital topographic data will be used for hydraulic modeling and floodplain mapping to produce Digital Flood Insurance Rate Maps (DFIRMs) for Shenandoah County.

2. **Period of Performance:** This Mapping Activity will begin on October 1, 2001 and will be completed no later than September 30, 2002. This Mapping Activity may be terminated at the option of FEMA or Shenandoah County in accordance with the provisions of the June 26, 2001, CTP Memorandum of Agreement.

3. **Funding/Cost-Sharing:** FEMA will fund $3,170 for this activity.

4. **Standards:** The following standards and documents are relevant to this Mapping Activity:
   - Survey Methodology:
     - Global Positioning System (GPS) Surveys: Follow National Geodetic Survey publication NGS-58, "Guidelines for Establishing GPS-Derived Ellipsoid Heights (Standard: 2 cm and 5 cm)," November 1997.
     - Aerial Surveys: Follow United States Army Corps of Engineers (USACE) EM 1000-1-1000, "Photogrammetric Mapping," March 31, 1993.
     - Conventional Surveys: Follow standard American Congress on Surveying and Mapping (ACSM) procedures.
     - Hydrographic Surveys: Follow USACE EM 1110-2-1003, "Hydrographic Surveys," October 31, 1994.
   - Draft LIDAR specifications are available on FEMA's Web site at www.fema.gov/mit/tsd/MM_lidar.htm.
   - *Guidelines and Specifications for Study Contractors* (FEMA 37). FEMA is in the process of revising Aerial Mapping and Surveying Specifications in FEMA 37, Appendix 4. The revisions will include procedures for evaluating Triangulated Irregular Network (TIN) data in accordance with the new National Standards for Spatial Data Accuracy (NSSDA) for data used in automated and semi-automated hydrologic and hydraulic modeling. Once those specifications are complete, they will apply to this Mapping Activity.
   - Digital mapping submissions will comply with the requirements of Chapter 9 and Appendix 7 of FEMA 37.
   - It is understood that Air Survey will provide contouring and DTM sufficient to provide vertical information to +/- 4 foot accuracy.

5. **Products:** Shenandoah County shall make the following products available for the Stony Creek from the confluence with the North Fork Shenandoah River upstream approximately 22 miles to 7000 feet upstream of the Route 263 crossing:
   - TIN data on CD-ROM.
   - Hardcopy topographic maps.
   - Report summarizing methodology and results.
   - Completed Form 5 of *Revisions to National Flood Insurance Program Maps, Application/Certification Forms and Instructions* (MT-2).
   - Checkpoint analyses to assess the accuracy of TIN data, including Root Mean Square Error (RMSE) calculations to support vertical accuracy.
   - Identification of remote sensing data voids and methods used to supplement data voids.
   - National Geodetic Survey (NGS) data sheets for Network Control Points (NCP) used to control remote sensing and ground surveys.

6. **Schedule and Milestones:**

   Milestone 1: Products for the first milestone to be provided to the FEMA Project Officer include:
   - Documentation of methodology, data analyses, date of survey/data collection, NCP, and other relevant information.
   - Work plan for supplementing data voids caused by limitations of remote sensing and/or source of any supplementary data collection.

   Milestone 2 (Final Products): Final products for the first milestone to be provided to the FEMA Project Officer include:
   - TIN data on CD-ROM.
   - Hardcopy topographic maps.
   - Report summarizing methodology and results.
   - Completed Form 5 of MT-2.
   - Checkpoint analyses to assess the accuracy of TIN data including RMSE calculations to support vertical accuracy.
   - Identification of remote sensing data voids and methods used to supplement data voids.
   - NGS data sheets for NCP used to control remote sensing and ground surveys.

   Final products will be made available in accordance with the Period of Performance described in Section 2 of this Mapping Activity Statement.

7. **Certification:** The following certifications apply to this Mapping Activity (as appropriate):
   - Registered Professional Engineer or Licensed Land Surveyor will certify topographic information, in accordance with 44 CFR 65.5(c).
   - Certification of topographic information by the American Society for Photogrammetry and Remote Sensing (ASPRS) is also acceptable.

8. **Technical Assistance and Resources:** Shenandoah County may obtain copies of FEMA-issued Letters of Map Change (LOMCs), archived engineering back-up data, and data collected as part of the Mapping Needs Assessment Process from FEMA's Mapping Coordination Contractor (MCC). The MCC may be contacted at 1-877 FEMA MAP (1-877-336-2627). General technical and programmatic information, such as FEMA 265, the Quick-

2 computer program, and the MT-2 forms, can be downloaded from FEMA's Flood Hazard Mapping Web site (www.fema.gov./mit/tsd/). Specific technical and programmatic support may be provided through FEMA's MCC; such assistance should be requested through the FEMA MCC Project Officer specified in Section 12 of this Mapping Activity Statement.

Shenandoah County may also consult with the FEMA MCC Project Officer to request support in the areas of selection of data sources, selection of digital data accuracy standards, assessing vertical data accuracy, selection of data collection methods, selection of sub-contractors, and GIS-based engineering and modeling training.

9. **Contractors:** It is anticipated that Air Survey will provide subcontracted services to Shenandoah County. Procurement of subcontractors using Federal funds provided as part of this Mapping Activity will comply with the requirements of 44 CFR 13.36.

10. **Quality Assurance/Quality Control (QA/QC) Procedures:** Shenandoah County will undertake internal QC reviews to ensure that the products described under Section 5 of this Mapping Activity Statement conform with the standards outlined under Section 4 of this Mapping Activity Statement. Additionally, Dewberry and Davis will undertake an independent review for compliance with these standards. The QA/QC procedures outlined in Chapter 10 of FEMA 37 should be followed during the development of the approximate Zone A analyses and mapping.

11. **Reporting:** Reporting will be required as stated in the grant approval letter.

12. **Points of Contact:** The FEMA Regional Project Officer is Jon Janowicz, and the CTP Project Manager is Christopher Way or subsequent personnel of comparable experience who are appointed to fulfill these responsibilities. If it is necessary, the assistance of FEMA's MCC should be requested through the FEMA MCC Project Officer, Douglas Bellomo.

Each party has caused this Mapping Activity Statement to be executed by its duly authorized representative.

Christopher Way, GIS Coordinator
Shenandoah County, Virginia

9-24-01
Date

Jon Janowicz, P.E.
Region III, Civil Engineer

10/1/01
Date

Shenandoah County, Virginia
Cooperating Technical Partner
Mapping Activity Statement

Agreement CTP01-02 - Hydrologic and Hydraulic Analyses and Floodplain Mapping

In accordance with the Cooperating Technical Partner (CTP) Memorandum of Agreement dated June 26, 2001, between Shenandoah County, Virginia and the Federal Emergency Management Agency (FEMA), Mapping Activity Statement CTP01-02 is as follows:

1. **Objective and Scope:** The objective of this Mapping Activity is to develop a limited detail hydrologic and hydraulic analyses and floodplain mapping for Stony Creek. Hydrologic analyses will be completed for the upper watershed, and hydraulic analyses and floodplain mapping will be completed for approximately 10.2 linear miles of limited detail study. (Limited detail hydraulics for the reach beginning 1000' downstream of the Route 691 Crossing upstream to a point 0.5 miles above the upper end of Lake Laura.)

   GIS-based hydrologic and hydraulic modeling and mapping techniques can be applied to develop GIS data sets in support of the automation or semi-automation of modeling and floodplain mapping.

2. **Period of Performance:** This Mapping Activity will begin on October 1, 2001 and will be completed no later than September 30, 2002. This Mapping Activity may be terminated at the option of FEMA or Shenandoah County in accordance with the provisions of the June 26, 2001, CTP Memorandum of Agreement. The period of performance will be in accordance with Agreement Article II.

3. Funding/Cost-Sharing: FEMA will fund $30,000 for this activity.

4. **Standards:** The following standards and documents are relevant to this Mapping Activity:
   - Limited detail hydrologic and hydraulic analyses and floodplain mapping will follow the standards set forth in FEMA 37, *Guidelines and Specifications for Study Contractors* (January 1995), and Title 44 of the Code of Federal Regulations (CFR), Part 65. FEMA 37 is available at FEMA's Web site at http://www.fema.gov/mit/tsd/EN_reg.htm. Title 44 of the CFR is available at FEMA's Web site at www.access.gpo.gov/cgi-bin/cfrassemble.cgi?title=199944.
   - Computer models used for hydrologic and/or hydraulic analyses will meet the requirements of 44 CFR 65.6(a)(6) and be on FEMA's *Numerical Models Accepted by FEMA for NFIP Usage* (http://www.fema.gov/mit/tsd/EN_modl.htm).
   - Topographic mapping used to delineate floodplains and floodways will be of adequate scale and topographic definition to provide reasonable accuracy. Planimetric features will be compatible with the base map (with respect to horizontal accuracy) selected by FEMA for Digital FIRM production. Topographic mapping taken from aerial photogrammetry or surveys will comply with the requirements of Appendix 4 of FEMA 37, (Shenandoah County photography will be used with enhanced topo development to generate 4

contours from original data that meets 8' National Map Accuracy Standards. The selection of the topographic mapping source to be used will be coordinated with the FEMA Regional Project Officer prior to analysis and mapping.

- Any levee or dike systems to be shown on the community's FIRM as providing protection from the 1% annual chance flood will comply with the requirements of 44 CFR 65.10. Chapter 7 of FEMA 37 provides guidelines for evaluating levee and dike systems.
- Flood elevations and floodplain boundaries will reasonably tie in to non-revised information in accordance with 44 CFR 65.6(a)(2).
- Digital mapping will comply with the requirements of Chapter 9 and Appendix 7 of FEMA 37.
- If implemented, automated data processing and modeling algorithms for GIS-based modeling and mapping will be documented and provided to FEMA to ensure that they are consistent with the standards outlined above. Digital data sets (such as elevation, basin, or land use data) will be documented and provided to FEMA for approval prior to performing the analysis to ensure that they meet minimum requirements. If non-commercial (i.e., custom developed) software is used for the analysis, then full user documentation, technical algorithm documentation, and the software will be provided to FEMA for review prior to performing the scope of work.
- Digital Elevation Models (DEMs) and field survey data will meet vertical accuracy requirements contained in Appendix 4 of FEMA 37.

5. **Products:** Shenandoah County will make available items outlined in Chapter 11 of FEMA 37 in the Technical Support Data Notebook (TSDN) format. These include:
   - Digital 1% and annual chance floodplain boundaries;
   - Digital profiles of the 10%, 2%, 1%, annual chance water-surface elevations, representing existing conditions;
   - Flood Insurance Study (FIS) report;
   - Digital copies of all hydrologic and hydraulic modeling (input and output files); and
   - All back-up data used in the analyses or mapping.

   For GIS-based modeling and mapping, Shenandoah County will deliver all digital input and output data, intermediate data processing products, GIS data layers, and final products in the format of the Digital Flood Insurance Rate Map (DFIRM) database structure.

6. **Schedule and Milestones:**

   Milestone 1 (Scoping Phase): Products for the first milestone to be provided to the FEMA Project Officer include:
   - Annotated copies of effective FIRMs depicting limits of proposed study.
   - Documentation of the proposed source of topographic data, scale, contour interval, source/methodology, date of survey/data collection, vertical and horizontal datums, and comparison of planimetric features with the DFIRM base map selected by FEMA for DFIRM production.
   - A written summary of the initial data research, proposed analysis methodologies, and a work plan.

- Documentation of digital data sets to be used (such as elevation, basin, and land use data). Full user documentation, technical description of methodologies and algorithms, and a copy of the source codes and custom-developed software applications for GIS-based modeling will also be provided.
- Copies of topographic maps depicting proposed cross section locations.

Milestone 2 (Hydrology Phase): Products for the second milestone to be provided to the FEMA Project Officer include draft hydrologic analyses in accordance with the TSDN format.

Milestone 3 (Hydraulics Phase): Products for the third milestone to be provided to the FEMA Project Officer include the hydraulic models and sample floodplain mapping in accordance with TSDN format.

Milestone 4 (Final Products): Final products to be provided to the FEMA Project Officer include:
- The completed TSDN and accompanying data containing the information outlined in Section 5 of this Mapping Activity Statement.
- A QA/QC report documenting the results of the independent review of all computational and data processing procedures.

Final products will be made available in accordance with the Period of Performance described in Section 2 of this Mapping Activity Statement.

7. **Certification:** The following certifications apply to this Mapping Activity (as appropriate):
   - Hydrologic and/or hydraulic analyses and data will be certified by a registered Professional Engineer or Licensed Land Surveyor in accordance with 44 CFR 65.6(f).
   - Topographic information will be certified by a registered Professional Engineer or Licensed Land Surveyor in accordance with 44 CFR 65.5(c).
   - If fill is to be considered in the mapping to raise land areas to or above the 1% annual chance flood elevation, certification of the fill will be provided in accordance with 44 CFR 65.5(a)(6) by the community's NFIP permit official, a registered Professional Engineer, or a Licensed Land Surveyor.
   - Any levee systems to be accredited as discussed in Section 4 of this Mapping Activity Statement will be certified in accordance with 44 CFR 65.10(e).

8. **Technical Assistance and Resources:** Shenandoah County may obtain copies of FEMA-issued Letters of Map Change (LOMCs), archived engineering back-up data, and data collected as part of the Mapping Needs Assessment Process from FEMA's Mapping Coordination Contractor (MCC). The MCC may be contacted at 1-877 FEMA MAP (1-877-336-2627). General technical and programmatic information, such as FEMA 265, the Quick-2 computer program, and the MT-2 forms, can be downloaded from FEMA's Flood Hazard Mapping Web site (www.fema.gov./mit/tsd/). Specific technical and programmatic support may be provided through FEMA's MCC; such assistance should be requested through the FEMA MCC Project Officer specified in Section 12 of this Mapping Activity Statement.

Shenandoah County may also consult with the FEMA Project Officer to request support in the areas of selection of data sources, digital data accuracy standards, assessment of vertical data accuracy, data collection methods or sub-contractors, and GIS-based engineering and modeling training.

9. **Contractors:** Shenandoah County anticipates using a subcontractor to assist in the development of the hydrology, hydraulics and mapping of the Stony Creek. Procurement of subcontractors using Federal funds provided as part of this Mapping Activity will comply with the requirements of 44 CFR 13.36.

10. **Quality Assurance/Quality Control (QA/QC) Procedures:** Shenandoah County will undertake internal QC reviews to ensure that the products described under Section 5 of this Mapping Activity Statement conform with the standards outlined under Section 4 of this Mapping Activity Statement. Additionally, Dewberry and Davis will undertake an independent review for compliance with these standards. The QA/QC procedures outlined in Chapter 10 of FEMA 37 should be followed during the development of the approximate Zone A analyses and mapping.

    For GIS-based, automated modeling, QA/QC activities should ensure automated calculations are reasonable and in compliance with standard flood modeling and mapping approaches. Shenandoah County will document internal QA/QC procedures to ensure all calculations and data processing were reviewed.

11. **Reporting:** Reporting requirements will be in accordance with Agreement Articles V & VI.

12. Points of Contact: The FEMA Regional Project Officer is Jon Janowicz, and the CTP Project Manager is Christopher Way or subsequent personnel of comparable experience who are appointed to fulfill these responsibilities. If it is necessary, the assistance of FEMA's MCC should be requested through the FEMA MCC Project Officer, Douglas Bellomo.

Each party has caused this Mapping Activity Statement to be executed by its duly authorized representative.

Christopher Way, GIS Coordinator
Shenandoah County, Virginia

9-24-01
Date

Robert Gunter
Federal Emergency Management Agency

10/1/01
Date